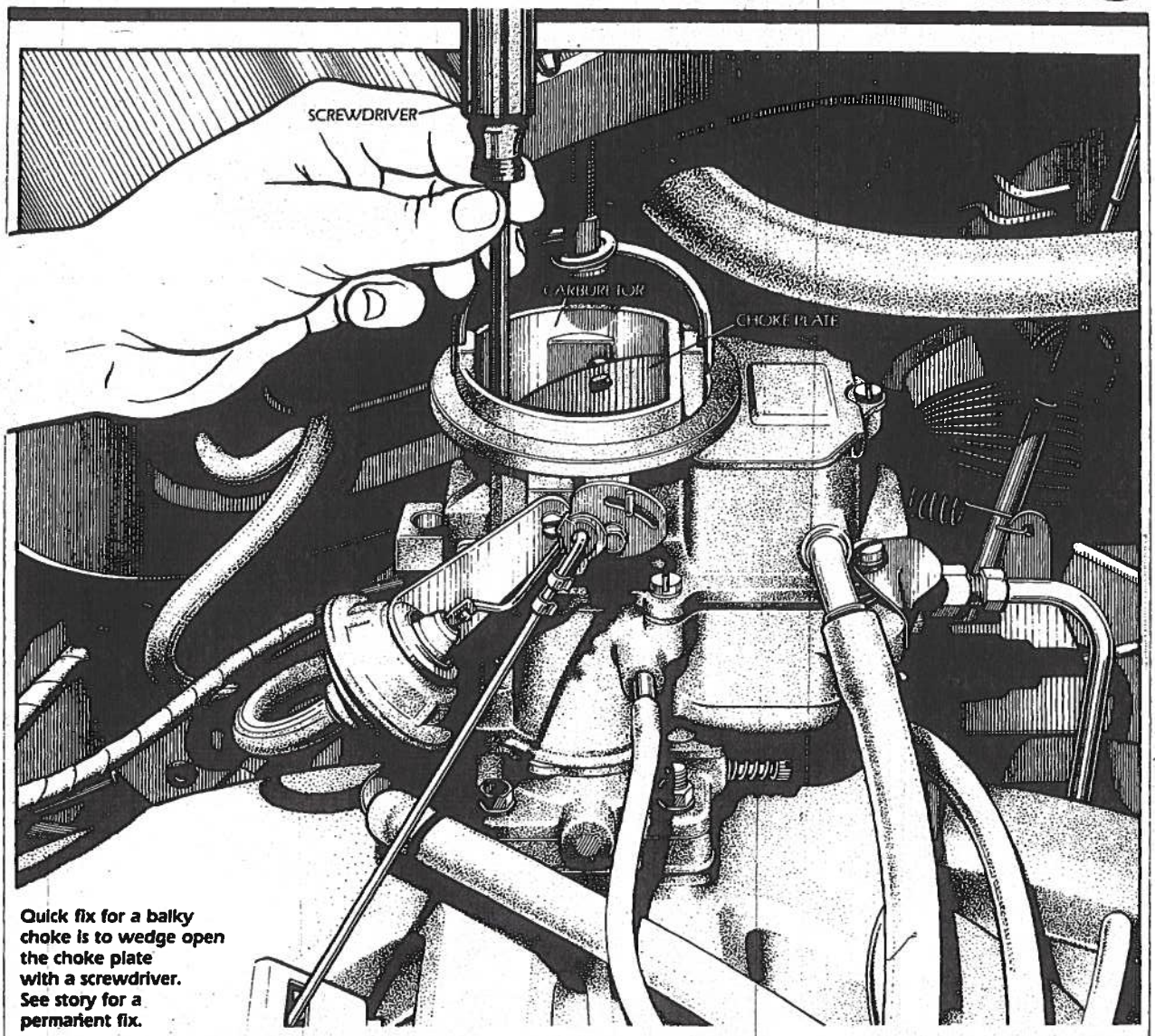
SATURDAY MECHANIC



Quick fix for a balky choke is to wedge open the choke plate with a screwdriver. See story for a permanent fix.

SOLVING HOT-START PROBLEMS

BY PAUL STENQUIST

It's a hot day in the middle of August. You park your car for 30 minutes or so while you do a bit of shopping. When you return you discover that the car, which started easily on the coldest mornings last winter, won't start now.

Hot-starting problems are a common source of driver distress. Because they sometimes go away when the engine has cooled completely, they can be very difficult to diagnose.

Hot-start problems can be divided into two categories: those that cause the engine to crank so slowly that it won't fire and those that make the engine hard to start but don't affect cranking speed.

Hot start, slow crank

Here, when you turn the key to the START position, the engine sounds like it's turning one revolution at a time with a pause between each. The engine may suddenly begin to crank faster, or it may just continue cranking laboriously until the battery is dead.

If it occurs only once, it may be due to nothing more than a discharged battery or inoperative charging system. If it occurs often when the battery is fully charged, it may be the result of high cranking circuit resistance, internal en-

gine problems, cooling system problems, excessive spark advance, or several of these conditions in combination.

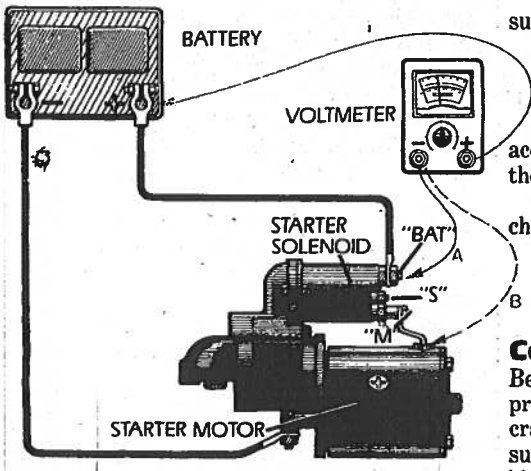
High cranking resistance

When corrosion or loose connections in the starting circuit raise circuit resistance, your battery might have a tough time cranking the engine. And, because resistance increases further when underhood temperature is high, the problem may be noticeable only on hot summer days.

Before even attempting to diagnose the problem, clean the battery posts and terminals as well as the connection points on the starter motor, starter relay and/or solenoid. Reinstall the terminals and make sure all connections are tight. Start the engine and warm it to maximum operating temperature by driving it slowly for at least half an hour. Then check starter positive and negative circuit resistance by measuring voltage drop.

To check positive circuit voltage drop, connect the positive cable of a voltmeter that reads in tenths of a volt to the positive battery post and the negative cable to the terminal on the starter (see Fig. 1). On starters with external solenoids (including most GM cars), connect the negative lead to the large copper connector that joins the solenoid to the starter. Crank the engine with the meter attached. It should read less than .5 volt if circuit resistance is within limits.

If you get a reading in excess of .5 volt on a car with an external solenoid, attach the negative probe of the voltmeter to the BAT terminal on the solenoid where the battery cable is attached. If there is less than .5 volt to this point with the engine cranking, but more than .5 volt at the bridge between the starter and solenoid, the resistance problem is within the solenoid.



1 To check resistance on starters with external solenoids, connect meter as shown.

High solenoid resistance is very common on some GM cars. The problem is due to a buildup of corrosion on the brass disc that transmits voltage to the starter when the solenoid engages. New Delco solenoids have an improved design contact plate, so rather than purchase a rebuilt solenoid, buy a new one from your GM dealer.

If positive circuit resistance was excessive at both points, the problem is in the positive battery cable or its connections. Replace the cable and recheck all terminals for corrosion.

Check negative circuit resistance by connecting the voltmeter's negative lead to the negative battery post and the meter's positive lead to the starter housing. Make sure you make contact with the bare metal of the housing. When the engine cranks the ground circuit, voltage should drop less than 0.2 volt. If not, check all connections again and replace the ground cable if necessary. If the ground circuit cable is attached to the frame, make sure that the cable joining the frame and engine is in good condition. By connecting your voltmeter's positive lead to various points in the ground circuit you can usually pinpoint the problem area.

Excessive spark advance

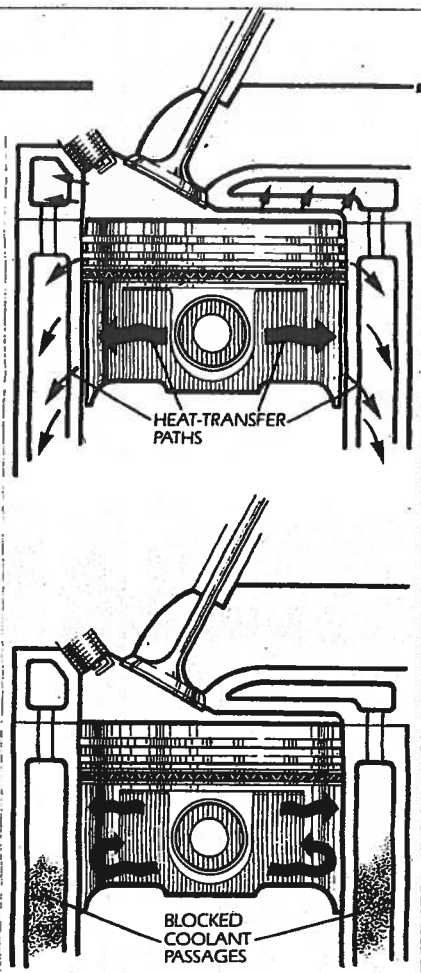
Slow crank/hot problems are frequently caused by a combination of high resistance and excessive advance, so it's a good idea to check spark timing even if you think you've solved your problem with a solenoid or cable replacement.

First, attach a tachometer and make sure idle speed is at specification. Then, check timing following the directions on your vehicle information label or in your shop manual. If the manufacturer provides a range of acceptable timing, adjust to a figure at the lower end of the range.

On cars with mechanical advance, check the centrifugal weights inside the distributor to make sure that corrosion isn't causing them to stick when the engine is hot.

Cooling system problems

Believe it or not, serious cooling system problems can cause hot start/slow crank problems. If coolant passages surrounding engine cylinders are blocked with sludge and corrosion, heat from the pistons won't be transferred to the coolant (see Fig. 2). This causes the pistons to expand to the point where friction between them and the cylinder walls makes the engine difficult to turn.



2 Heat flows easily from piston to coolant in normal cooling system (top). In clogged system, piston can expand enough to drag.

This can sometimes be remedied by a power backflush combined with a cooling system cleaner. In severe cases, cylinder block replacement may be the only solution.

Ordinary overheating problems can also cause an engine to crank slowly when hot, so check the cooling system thoroughly.

Internal engine problems

Any internal engine problem that produces friction can cause the engine to crank slowly. And since most clearances tighten up when the engine is hot, it's most likely to happen then.

You can tell if your engine is hard to turn by removing the plugs and attempting to turn the front crankshaft bolt with a torque wrench. It should break away at 90 lb.-ft. or less and should turn with the application of 70 lb.-ft. or less.

Internal engine damage might occur

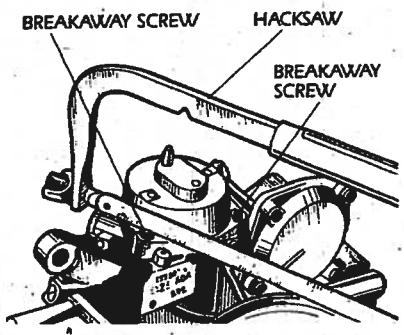
in combination with, or as a result of, blocked cooling system passages. The torque wrench test can't tell you for sure that the problem is due to one or the other. So before disassembling your engine or asking the mechanic to do so, make sure you've exhausted more conventional remedies.

Fast crank, no hot start

What about cars that crank fast when the engine is hot but still won't start? This problem is usually the result of a choke system failure, a fuel flooding problem, a serious vacuum leak, fuel starvation or an intermittent electrical failure. If your car is in need of a tuneup, do that before looking for more unusual causes.

Choke problems

The scene is repeated over and over again in supermarket parking lots during the heat of summer. After a futile attempt at starting his car, the driver jumps out, throws up the hood, un-



3 Remove carb from engine if necessary to cut slots in choke housing screws.

screws the air cleaner and jams a screwdriver between the choke plate and carb body (see opening illustration). After starting the car, he reverses the procedure, slips behind the wheel and drives away.

The culprit could be an incorrect choke adjustment, but you must also consider the carburetor flooding problems discussed below. Although the screwdriver holds the choke flap open, that may only be necessary due to engine flooding.

Choke adjustment and cleanup, though, are the first two things you should consider. Make sure the engine is cold. Use a small solvent brush and a can of carb cleaner, or an aerosol can of carb cleaner, to remove all the varnish and accumulated dirt from the linkage arms and choke assembly.

Because there are a number of different choke mechanisms on recent carburetors, we can't provide exact directions or specs for checking each. So to do this job properly, you'll need a service manual. Most choke systems require at least three adjustments: vacuum break, choke flap closing and fast idle. Some call for as many as five or six different adjustments.

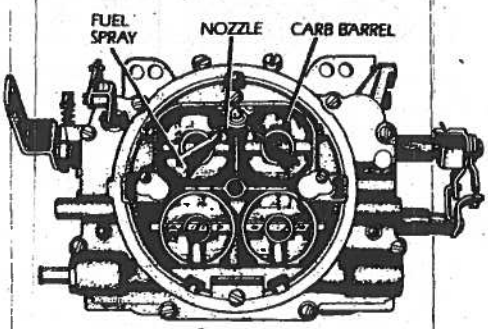
On most systems, a temperature-sensitive bimetal coil, mounted either on the carb body or within a stove on the intake manifold, opens and closes the flap. On some, the coil is heated electrically, on others, exhaust heat is used. Adjustment is frequently accomplished by turning the housing that surrounds the bimetal coil until a pointer aligns with a specified point on a scale that is attached to the carb body. On others, the housing is mounted in a fixed position and adjustment is made by bending a linkage rod or lever. Sometimes the correct choke flap position must be gauged with a rule, or with a drill bit or rod gauge.

On most cars, the choke housing is mounted with rivets or slotless screws to discourage tampering. To remove rivets, drill them out. To remove slotless screws, make a slot in each with a hacksaw blade (see Fig. 3).

Choke flap sticking can become a problem on very old carburetors or poor rebuilds if the choke flap bushings have worn to the point where the flap won't stay in one position and can't be adjusted properly.

Bowl vent boilover

When you park your car, heat from the engine is transferred to the fuel remaining in the carb float bowl. The temperature increase is accompanied by rising pressure. This pressure has to be relieved or fuel will be forced into the intake manifold. Once the manifold becomes soaked with fuel, the engine floods and can only be started by holding throttle and choke flap wide open. If you're greeted with a powerful gasoline odor when you open the hood, the engine is most likely flooded.



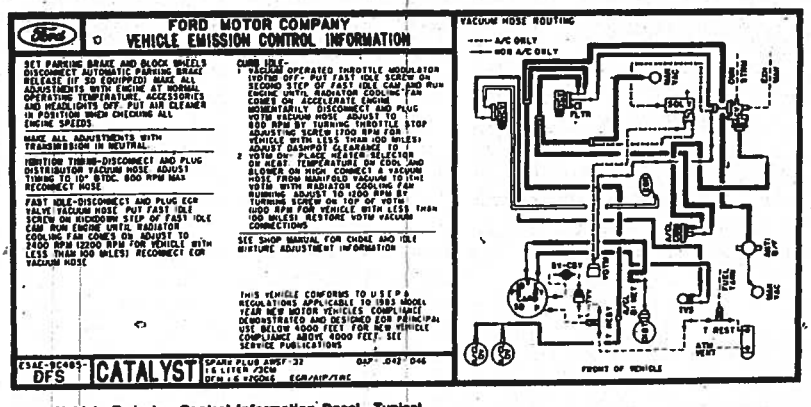
5 Fuel should spray from accelerator pump nozzles when throttle is opened manually.

On most cars, the float bowl is vented to the evaporative emissions canister. The vent must be open when the engine is shut off or high pressure within the bowl will force fuel through the carb metering circuit.

Check the bowl vent and any connecting hoses for possible blockage. If they're okay, take a look at the canister. If the bottom of the canister is open, you can usually replace its filter. If a closed canister drips fuel from the bottom, replace it and troubleshoot the evaporative emissions system (see your service manual).

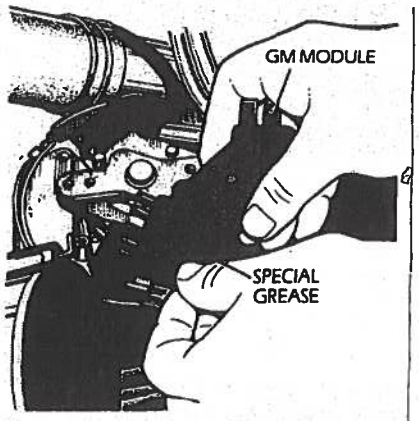
Internal carb leaks

If you find that your bowl vent system is okay but your engine continues to flood when it's shut off hot, the carbure-



Vehicle Emission Control Information Decal—Typical

4 Decal in engine compartment shows vacuum hose routing and spark advance specs.



6 Dielectric grease on the back of GM ignition modules can prevent heat damage.

tor probably has an internal leak.

Before you invest in a new carb, make sure your engine is running at normal temperature. Even a good carburetor may spit fuel into the engine if it's running 30° or 40° above normal.

Vacuum leaks

If your engine is hard to start hot but does not seem to be flooded with excess gasoline, a vacuum leak could be the problem. Check all hoses for splits, kinks and other signs of damage. If they're old and brittle, replace them. Make sure all hoses are connected in the manner illustrated on the emissions information label (see Fig. 4).

In addition to making hot restarts difficult, a vacuum leak will cause a rough idle. To find a vacuum leak that is not the result of an obviously defective hose, use a needle-nose pliers to squeeze off each vacuum hose near its source while the engine is idling. When the roughness clears up, you've found the leak. If the hose itself is okay, the component it's attached to may be bad.

An EGR valve that sticks open qualifies as a vacuum leak, as it allows the engine to draw air through the exhaust passages when you're trying to start it. On most engines you can check the EGR valve by applying vacuum to it with a hand-held vacuum pump while the engine is idling. When the vacuum signal causes the valve to open, the engine will idle roughly. When you release the vacuum, the valve should close and proper idle should be restored. If the application of vacuum to your EGR valve does not cause it to open, check your service manual for EGR test procedures.

Fuel starvation

While excess fuel is a common cause of hot-start problems, they also can be the result of fuel starvation. In these cases, the engine cranks until the pump has filled the float bowl sufficiently. Then it finally starts.

You can tell if your engine is getting a supply of fuel by removing the air cleaner and looking down the carburetor barrels. (Do this while the engine is off and the starting problem is present. Take care not to burn yourself on hot engine parts.) While holding the choke flap open, crack the throttle. You should see fuel shoot out the accelerator pump nozzles (see Fig. 5). If you don't, check the fuel filter, fuel pump and carburetor float adjustment.

Electrical problems

Some electronic parts can fail temporarily when underhood temperatures are high. Unlike our previous examples, the engine will start only after having cooled off for an hour or two.

The most likely offender in these cases is the electronic ignition module. Off-brand discount-priced modules seem to be more likely to fail than name brand or original equipment types. Applying dielectric silicone grease to the underside of GM modules reduces the chance of heat damage and hot restart problems (see Fig. 6). Have a mechanic test the old module before you buy a new one; these expensive electronic parts cannot be returned.

Fuel-injected engines

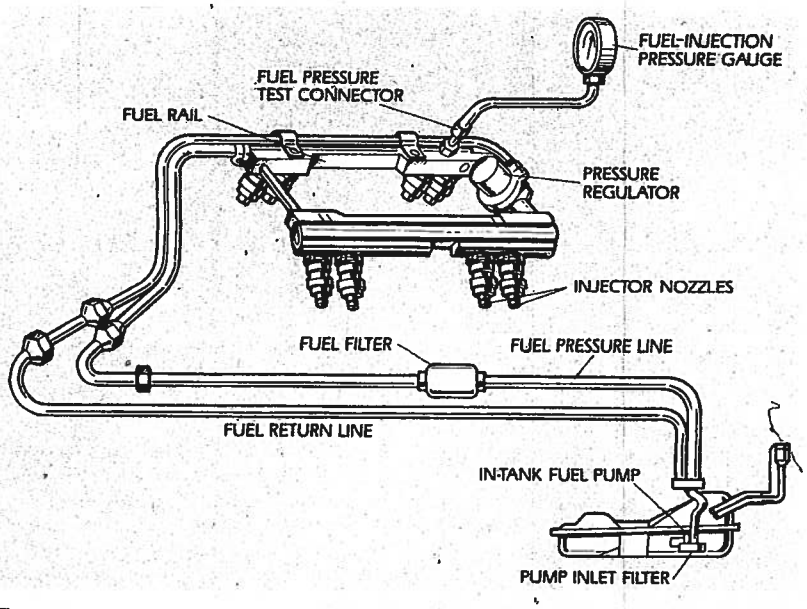
Because most injection systems remain pressurized after the engine is shut off, a fuel injector that sticks open can flood the engine and foul one or more plugs. Given enough time, the fuel evaporates and the engine starts easily. But for the first hour or so after shutoff, starting can be extra tough.

On port-injected engines (one injector per cylinder), a sticking injector can sometimes be located by checking the plugs half an hour after shutoff. If a plug is fouled or wet, it's likely that the injector for that cylinder is leaking.

A lack of wet plugs doesn't necessarily rule out dripping injectors. A visual check of the injectors is the best test. On throttle-body injection systems (central injectors within a carb-like body), the injectors are easy to observe and you can simply warm the engine, shut it off, remove the air cleaner and watch the injector(s) to see if there's a drip. On some port-injected systems you can lift the injectors and fuel rails out of the ports to watch for drips.

A check of system pressure is also useful in tracking down leaking injectors. If pressure drops continuously after the engine is shut off, a leaking injector could be the cause. But other problems—like a faulty fuel pump check valve, a leaking pump connection or a bad pressure regulator—can cause pressure loss as well.

On most systems you can measure pressure by attaching a fuel-injection pressure gauge to the Schrader valve, which looks like a tire valve. When attaching the gauge, wrap a rag around the gauge connector to catch any pressurized fuel that squirts out. PM



7 To check for leaking fuel-injector nozzles, attach pressure gauge to Schrader valve.